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## KINETIC STATISTICS AS AN AID TO PRODUCTION AND DISTRIBUTION

By WALTER N. POLAKOV

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Manufacturing concerns, particularly those of considerable size, have for years been in the habit of maintaining statistical departments. It has been generally assumed that statistics of manufacturing activities, compiled by gathering and classifying data, are of assistance to executives in shaping policies or detecting major shortcomings. But it was not until the development of kinetic statistics that the executive found an effective aid for getting things done.

The function of these old statistical interpretations was:

1. To establish relations, existing in the *past*, among numerous factors which have influenced production.
2. To prognosticate *future* probabilities as to volume of business, prices and costs, and the general trend of other influential factors.

The basis for such work was usually found in:

1. Diverse manufacturing and accounting records of the concern itself.
2. Such other outside data as was available and pertinent to the subject studied.

The usefulness of these efforts is commonly limited by the very nature of the undertaking, because:

1. What *has been* in the past is not necessarily an indication of what *will be* in the future under changed conditions; indeed, if it were so, there would be no improvement, no progress, no growth.
2. What has been or what is being done in no way carries the assurance that things are as they *should be*; indeed, so long as there is no gage of perfection, no evaluation of past and present performance can be made, and such an absence of preëstablished aim renders the whole activity a purely accidental character.

These two intrinsic limitations of the traditional *static* statistical method give it a passive character which neither leads nor judges but merely records. Even the very progress thus recorded in rows of figures or curves reflects the chance development and a fatalistic attitude rather than an activity directed by volition toward a definite goal. Specific though limited usefulness of this static method is of course not denied; but its intrinsic limitations are emphasized in con-

tradistinction with the newer method of kinetic statistics, which involves a study of the movement through time toward a set task.

In order to comply with two fundamental characteristics of human nature, namely, the lure of perfection and the relativity of cause and effect in time, any statistical method dealing with any human activity should recognize that (1) the facts in themselves or in relation to each other are of no human interest except when *compared with the desired results*, and (2) the attainment of the desired results is of no human value unless it is *attained within time specified*. To be more explicit: Consumption of 30,000 heat units per kilowatt hour energy produced may mean 95 per cent perfection in one plant and 50 per cent waste in another; to build a house for \$10,000 may be economical for the specification, but if it takes ten years to complete the construction, double the expense in six months would be more economical.

*In practice, kinetic statistics are based on one constant scale of time, and the actual accomplishment is invariably compared with a predetermined task to be completed within the given period of time.*

The practical task of controlling production must of necessity begin with measurement and, to be correct, measurements must be made in the proper dimension. It would be a grave blunder to apply a unit of one dimension to an entirely different dimension, or to use a measurement which contains a variable element. We cannot use for measuring human work the units of mechanical power such as foot-pounds or horse-power which embrace only the muscular work of men, even though these expressions contain the time rate, for it would be a confusion of part with the whole. The time rate of man's work is the only measure of production which is of the same dimensionality as the energy causing it, and it is as constant as the solar system itself.

Since time may be spent for different purposes and the amounts of work that can be done in a unit of time may of necessity differ, the scales may be as varied as are human activities themselves; but we cannot conceive human activity without or beyond time.

Time in its relation to our existence is divided into present, past, and future. Hence we have three fundamental managerial problems visualized in three forms of charts: as applied to the present or to current work—Man Record Charts; as referring to work done in the past—Machine Record Charts; and, finally, as projected to future work—Progress Charts, with their schedules laid out on the time scale of future requirements.

During the time devoted to productive work there is a variable amount of work done, as is shown on the Man Record Chart, but this work is performed and directed by men. "To feel the lure of perfec-

*Cutter (2)*

DEPT.

	MAN'S NO.	MON. 11	TUES. 12	WED. 13	THURS. 14	FRI. 15	SAT. 16	SUN. 17	MON. 18	TUES. 19	WED. 20	THURS. 21	FRI. 22	SAT. 23
A. T. White, Foreman														
Kloth, Sub-Foreman														
Schmidt, O.	1													
Petrusa, J.	17													
Braffett, P.	24													
Feis, Sr.	26	G												
Schluster, P.	42													
Henderson, H.	31													
McLaughlin, J.	3													
Midcenter, Sub-foreman														
Keenan, J.	84	I	A	L										
Volkammer, W.	78	G	S	G	A	M								
Cerlini, J.	33	N	L	L	M									
Mac Dowell, A.	57	I	I	A	I	A								
Mead, T.	43	G	G	G	A	G								
Haley, R.	36	V	M	M	Y									
Brown, W.	21													
Riley, A.	14													
Anderson, P.	18													

FIGURE 1.—MAN RECORD CHART

Width of daily space represents amount of work that should have been done in a day. Dash lines represent time taken to do work for which there was no time estimate. Solid thin lines represent the proportion of work done in a day, and heavy lines are the summaries. Letter symbols indicate the causes of delay or handicaps: A =absent; G =green operator; I=instructions lacking; L =slow operator; M =material troubles; R =repairs needed; T =tool trouble; V=holiday Y=smaller lot than estimate is based on.

tion," says Professor C. J. Keyser, "in one or more types of excellence, however lowly, is to be human; not to feel it is to be sub-human." And a chart of this kind involves that ideal of service. It shows what is expected to be accomplished within the work time for any occupation, however lowly.

In such a chart this ever-striving impulse of self-expression in service, which throbs in every human being, is given adequate expression and stimulus. It is accomplished by predetermining the ideal, however modest, which is accepted by a man as within his power of attainment. Then, and only then, can the lines of attainment be drawn from day to day to denote the falling short of the aim or the equaling and even surpassing it, as the obstacles of inertia, ignorance, or lack of coördination are overcome by the strongest of all human propensities—the desire to excel oneself. This type of chart can truthfully be called a tool for humanizing industry, for it not only reveals to a man his own dignity and capacity as a creator, but subtly, though persistently, calls for coöperation between the workers with brain and brawn. It tells what each of us and all of us are doing at the present time.

The Machine Record Chart reveals to one who reads between the lines much more than merely the time a certain machine was idle. Its scale is also time, but the time during which a machine remains unproductive has a graver significance than a reminder that "time is money." It means that some one who should have operated it or supervised its operation was not employed, and the time consumed in inventing, developing, and building this machine, which is greater in its productive significance than the time of the operator, is irretrievably lost.

Likewise, the Material Utilization Chart (like that of fuel utilization developed by the author), indicating the waste of material or energy, has a deeper meaning. It shows the extent to which the work of other men in recovering, preparing, and delivering this material or energy has been destroyed. It means that the work of hosts of men has been rendered useless and that their productive time is forever lost. This type of chart gives us the measure of our utilization of the work that has been done before. It proves whether we are worthy of our inheritance from the past.

Lastly, the Progress Chart integrates all elements of work, it sums up the progress made, its acceleration, its retardation, its time rate. Like other charts it brings together the ideal and the fact. Its ideal projects into the future and sets before us the task which we are called upon to perform, no matter how small or how great it may be, whether filling an order in a shop, feeding a nation, or advancing the life and

PRODUCTIVE MACHINES	DEPT.										TOTAL HOURS OF IDLENESS	DETAILS OF IDLENESS HOURS DUE TO							
	10	20	30	40	50	60	70	80	90	100		LACK OF HELP	LACK OF MATERIAL	LACK OF CIRCLES	LACK OF POWER	REFAINS	LACK OF WORK FOR SET-UP	HOLIDAY	
Week Ending July 5 <sup>th</sup>	5 <sup>th</sup>										1972	236	302	29	0	381	178	62	784
" 12	12										1478	259	436	250	0	333	152	48	0
" 19	19										1675	241	471	387	0	402	135	36	0
" 26	26										1478	206	523	115	88	357	147	42	0
August 2	2										1421	192	437	318	0	328	120	26	0
" 9	9										1336	180	413	318	0	303	104	18	0
" 16	16										1309	186	387	331	0	281	116	8	0
" 23	23										1205	175	307	336	0	294	83	12	0
" 30	30										1025	164	324	130	148	268	61	0	0
Sept. 6	6										1319	96	282	257	0	239	40	0	405
" 13	13										1151	168	253	154	0	178	29	0	369
" 20	20										873	101	206	340	0	191	35	0	0
" 27	27										882	83	263	460	0	64	12	0	0
Oct. 4	4										777	48	241	345	0	143	0	0	0
" 11	11										760	22	213	468	0	51	0	0	0
" 18	18										1035	35	178	416	0	58	8	0	360
" 25	25										815	16	192	558	0	49	0	0	0
Nov. 1	1										610	9	157	382	0	62	0	0	0
" 8	8										865	0	106	352	0	47	0	0	360
" 15	15										527	5	85	382	0	55	0	0	0
" 22	22																		
" 29	29																		
Dec. 6	6																		
" 13	13																		
" 20	20																		
" 27	27																		
SUMMARY OF IDLENESS CHART																			

FIGURE 2.—MACHINE RECORD CHART: SUMMARY OF IDLENESS

This chart compares the records of twenty succeeding weeks and illustrates the progress made toward removing the causes of idleness due to knowledge of the causes of idleness. The numbers given in tabulation are man-hours lost due to various classified reasons. If an average hourly man rate is \$1 and overhead \$2, the 1,500 hours of weekly idleness cost the company \$4,500 besides loss of profit on goods not produced. Incidentally, the purchasing power is also reduced by \$1,500 direct loss of earnings, etc.

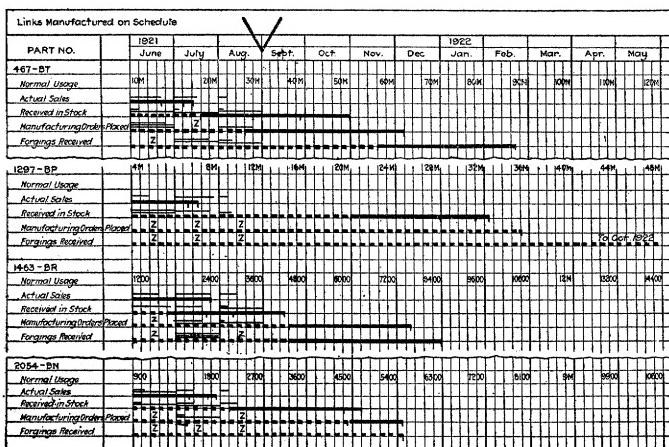


FIGURE 3.—PROGRESS CHART (continuous production)

The normal usage of 10,000 parts per month is compared with sales, production, orders placed, and parts received. Dash lines indicate the work done before June 1 when the chart was started. The chart is entered as of August 31. The figures at the left show amounts scheduled for the month; the figures at the right show the cumulative total to be done to date. All of these lines moved forward month by month, and the difference in the lengths of the cumulative lines always showed the parts in stock, the parts on order, and the parts on hand.

happiness of mankind. It calls for a plan and vision of the future. It is based on knowledge of the past, and it reveals our present position.

This time concept in the control of industry, direction of production, and measurement of human work thus stands revealed as the wished-for solution, free from error of confused types and dimensions. It refers all facts to the irreducible and final element of human life—time. But it is true to the human dimension, it is both human and humane; hence it obliterates conflicts between men and management, promotes the fullest exercise of man's creative forces, and places work in its proper relation to life.

An executive of a manufacturing concern which has used charts of this nature for several years recently told of his experience in these unequivocal words:

I have frequently seen charts bring up an average accomplishment to a standard previously thought impossible and within a comparatively short time justify an intelligent raising of the standard without creating any friction. Charts viewed daily admit of an examination of the entire operation; absence of charts permits an observation of just that proportion of the operation which an executive can keep actual watch over. Without charts an executive is utterly helpless and at the mercy of those on whom he depends for his departmental work. On the other hand, a daily supervision of the charts, with proper action taken on the necessities for action thus disclosed, will automatically insure a proper operating statement. If charts are used the arrival of the operating statement need not be anticipated with alarm.<sup>1</sup>

Similarly, in representing and directing selling efforts, such kinetic charts, if properly introduced with carefully worked-out quotas for each salesman within a certain time, fully comply with the two fundamental requirements, namely, that the actual be compared with the ideal, and that it be measured in terms of time. The results are invariably most stimulating and gratifying.

Finally, activities of national magnitude lend themselves with equal readiness to an efficacious kinetic chart presentation. Predetermined national consumption (demand) of various commodities, when compared within the time specified with actual deliveries (for satisfaction of the demand) on such a chart, readily discloses any maladjustment of distribution, as, for instance, when most needed commodities such as ammonia were hardly brought in at all, and perishable goods (such as bananas) were imported in an appalling excess. Adjustment of such cases and prevention of their repetition are greatly facilitated by the disclosures clearly and immediately made by the use of this method of kinetic statistics.

There is but one more point that need be covered in this paper: The

<sup>1</sup> See Wallace Clark, "Gantt Chart," Ronald Press, N. Y., 1922. Charts reproduced by courtesy of the author.

aid rendered by the charts of kinetic statistics is (1) immediate, (2) universal, and (3) does not conflict with any other method, statistical or administrative.

It is immediate because the data are gathered by men actually engaged in production, and therefore any falling-short of standard spurs them on toward improvement or the elimination of handicaps. *Before*

FIGURE 4.—SUMMARY OF IMPORTS: COMPARISON OF REQUIREMENTS WITH ACTUAL DELIVERIES OF COMMODITIES

The thin lines represent actual monthly deliveries drawn to a scale of monthly requirements. The heavy lines indicate cumulative totals. The figures denote monthly (left) and cumulative (right) requirements. Plurality of lines indicate excess of deliveries over the requirements, the length of one month's space = 100 per cent of estimated requirement.

the higher executives have an opportunity to criticize, they are asked to help.

It is universal since it is equally applicable to a small shop, to a great trust, a school, a railroad, or to a problem of national economy.

It does not conflict with any other form or manner of elaborating, combining, and presenting statistical data:—Kinetic charts have a mission quite their own—to tell while the thing is being done whether it is being done well, and if not, why not; and whether it will be done in time, and if not, what steps should be taken to get the thing done.